Extreme Habitats IV:
Turbulent Waters & Caves

FISH 310

What are the challenges of life in a **turbulent** habitat?

- High-energy zones in both marine and fresh waters
  - Waveswept rocky shores in the ocean
  - Rapids in rivers and streams
- Hard to remain in place, let alone feed and breed!

Morphological convergence in high-energy marine environments

- Dorsoventrally depressed, somewhat tapered bodies (= **terete**, teardrop shape)
- **Enlarged pectoral fins placed low on the body**
- May have **pelvic fins fused into a suction disk**

Neogobius melanostomus (Round Goby)

Gobiesox meaendricus (Northern Clingfish)

Morphological convergence in mountain stream environments

- Dorsoventrally depressed, small body, sometimes w/flattened ventral surface
- Large pectoral fins positioned low on the body
- Suction devices, such as the mouth, adhesive pads, or joined fins
- Subterminal or inferior mouths
- No swim bladder
- Respiratory behavior modifications:
  - Rapid inhalations followed by a quiescent period
  - Respiratory structures like incurrent openings @ top of gill cover or folds of skin covering the gills

sisorid catfish with adhesive pads on ventral surface

Psilorhynchus no gas bladder

Deep rivers as a high-velocity, **dark** environment

- Discharge of 23,000-50,000m^3s^{-1} of water on the stretch of the Congo River between Kinshasa & the Atlantic Ocean
- World's deepest river: > 220 m (720 ft) depth in some stretches

Lamprologus tigripictilis

Veterinary Ophthalmology (2013) **16**, 5, 359–364 DOI:10.1111/vop.12006

Comparative ocular anatomy in a blind African cichlid fish, *Lamprologus lethops*

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https://www.youtube.com/watch?v=tObYa9KQb8w

Images from Melanie Stiassny

Living in Caves

- Similar adaptations to cave life have evolved repeatedly in phylogenetically disparate groups of fishes
- Why?
  - Cons:
    - Food availability depends on infrequent replenishment
    - High atmospheric pressure (in some cases)
  - Pros:
    - Few competitors and predators
    - Constant moderate climate

Typhlichthys subterraneus
Southern Cavefish

Adaptations to life in a cave

- Lack of pigmentation
- Reduced squamation
- Expanded lateral line
- Reduction or loss of eyes & pineal gland
- Enlarged external chemosensory organs
- No schooling, dorsal light reaction, or circadian rhythms
- (Sometimes) expanded regions of tastebuds
- Increased fat storage
- Lower metabolic rates

Astyanax mexicanus
Blind Cave Tetra
aka Mexican Cavefish

Preadaptation, evolution, and convergence in cavefishes

- **Regressive evolution** reduces the size of now-useless organs
- **Hypertrophied** ("overdeveloped") structures arise for tasks necessary in the dark environment
- **Preadaptations** (particularly in characins) such as increased proclivity toward additional tastebud development, or toward blindness

Astyanax mexicanus
Blind Cave Tetra
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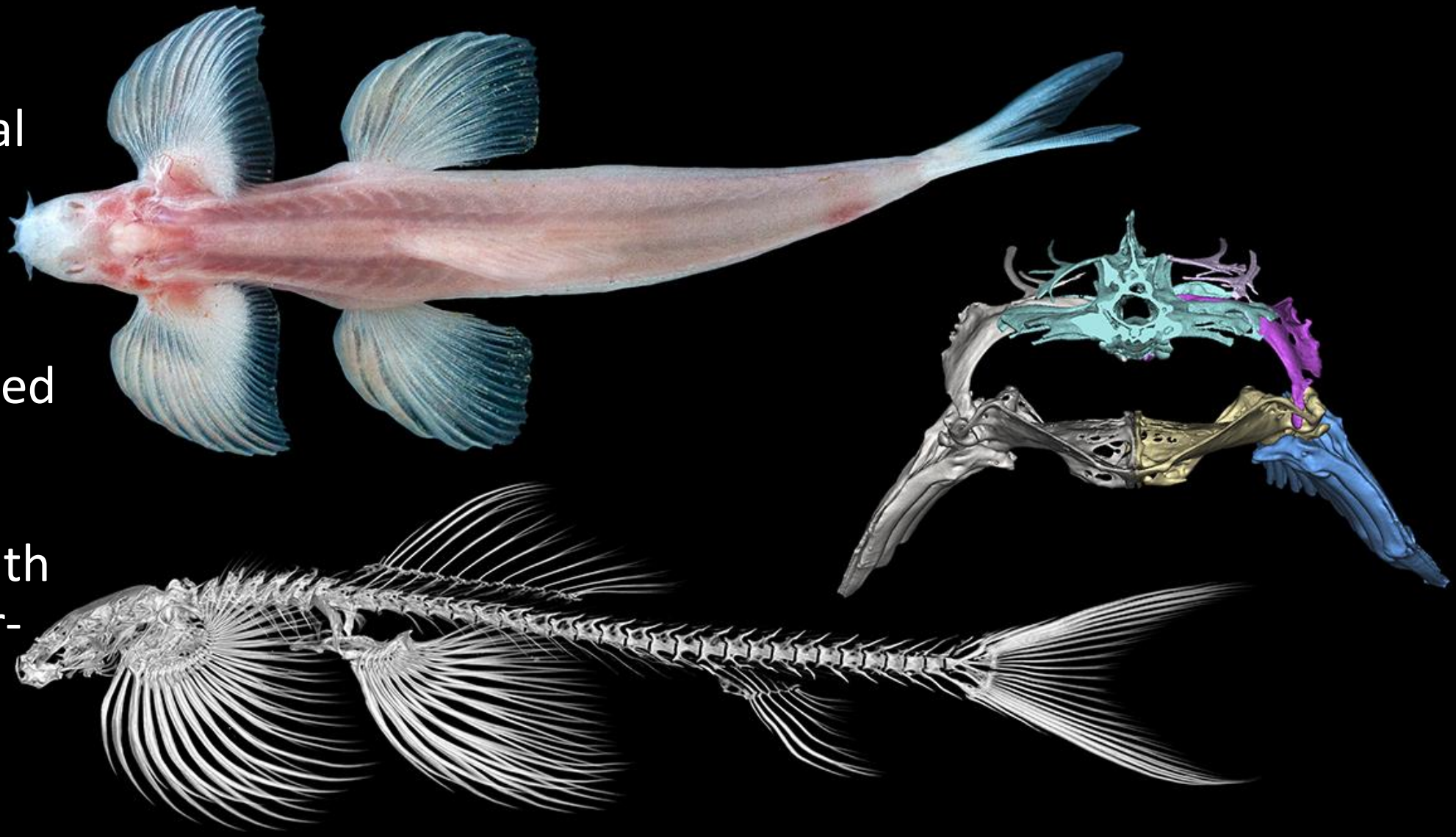
What type of swimming might be advantageous in a confined space or labyrinthine cave?

High flow & low light in the Cave Angelfish: ***Cryptotora thamicola***

- One of several ‘walking’ waterfall species
- Highly modified pectoral & pelvic girdles that ‘walk’ with a salamander-like gait



Florida Museum images by Zachary Randall